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Title: COLD BOX SHEET METAL JACKET

SUBMISSION OF ENGLISH TRANSLATION

Commissioner for Patents
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Sir:

Applicants attach herewith a verified English translation of the German language text filed on January 3, 2005.

The Commissioner is hereby authorized to charge any fees associated with this response or credit any overpayment to Deposit Account No. 13-3402.

Respectfully submitted,

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Description

Sheet Metal Jacket of a Cold Box

The invention relates to an enclosure for parts of a low-temperature air separation system that has side walls that extend perpendicular to the base surface of the enclosure, the extension of the enclosure perpendicular to the base surface defining its height, and the side walls each being lined with a sheet metal jacket consisting of several panels. Furthermore, the invention relates to a process for producing an enclosure that has side walls that extend perpendicular to the base surface of the enclosure.

In low-temperature air separation by rectification, the batch air to be separated is cooled beforehand and at least partially liquefied. The air is then separated by rectification into one or more columns at temperatures of roughly 100 K.

For thermal insulation, the cold parts, such as, e.g., columns, devices, pipelines or valves, are provided with an enclosure. The enclosure with the parts to be insulated is also called a cold box. An enclosure here is defined especially as jacketing or a shell that is suited for holding one or more components of the low-temperature air separation system and insulating them thermally against the environment. The enclosure is either itself thermally insulated or can be filled with suitable thermal insulation material.

These generally cuboidal enclosures to date have had a steel construction with a roof and side walls that are lined with sheet metal.

For insulation purposes, the cold box is conventionally filled with perlite. In the construction of the cold box, external effects, such as wind and possible earthquake, and internal effects, such as the inherent weight of the sheet metal, the internals and the pipelines as well as the perlite insulation and flushing gas pressure, are to be considered.

The object of this invention is to develop an enclosure that can be rapidly and efficiently installed and can be adapted flexibly to different dimensions of the internals to be insulated, but especially to the circumstances of the building sites.

This object is achieved according to the invention by a cold box of the initially mentioned type, in which in the direction of the height of the enclosure, the joints of the panels of one side wall all have essentially the same distance from one another.

The process according to the invention for producing an enclosure that has side walls that extend perpendicular to the base surface of the enclosure is characterized in that the side walls each are formed from several panels that each have a frame that is provided with a sheet metal lining, the panels being positioned and connected to one another.

For reasons of transport engineering, it is necessary to divide the side walls of the enclosure into several individual elements. According to the invention, this division takes place such that the side walls in the direction of the height of the enclosure, i.e., vertically, consist of several elements, hereinafter called panels.

By the division of the side walls according to the invention, the transport of the cold box is greatly facilitated since except for individual panels they all have the same height. Only the panel that is provided in the planned cold box on the lowermost or uppermost location or

individual panels that are provided, for example, with special ducts have a different extension in the direction of the height of the future cold box. Preferably the maximum height of all panels is determined by the height of most of the panels, i.e., most of the panels have the same height, and the height of the other panels is less than this height.

It is advantageous if the panels of one side wall each have the same extension in the direction perpendicular to the height of the enclosure. With the same dimensioning of the panels, transportation to the erection site is facilitated. For an enclosure with a rectangular base surface, it has been proven effective to dimension the panels of one side wall such that they extend in each case over the entire length or width of the side wall. The length and width are defined here by the boundaries of the base surface. Preferably, therefore, almost all panels of one side have the same size. Generally, only the uppermost and/or the lowermost row of panels has a differing height in order especially to equalize the difference between the necessary cold box height and the height that is possible based on the grid and in order to form the pitch of the roof.

In the direction of the height of the enclosure, the panels preferably have an extension of 2 to 4 meters, especially preferably 3 meters. This preferred dimensioning of the panels avoids transport problems, for example by exceeding conventional transport widths. Thus, for example, widths up to 3 meters with standard truck transport are possible; at widths up to 3.5 meters, only a vehicle accompanying the truck transport is necessary.

Moreover, a height grid of 3 meters corresponds to the height of flights of stairs that is the maximum allowable in many regulations. Walkways that can be attached to the enclosure can thus be connected to the corresponding panels before final assembly of the enclosure, by which

the degree of prefabrication is further increased.

The panels advantageously have a frame of U-sections that run peripherally on four sides, which frame is provided with lining sheet metal.

The frame of the panels is dimensioned such that the inherent weight of the cold box and the forces that occur at the erection site and that can be caused, for example, by wind or earthquakes are accommodated. Preferably the frame is executed such that the legs of the U-section each point to the inside, i.e., that the frame is bordered to the outside by the base and the legs of the U-sections. Thus, the panel has three smooth outer sides, by which a connection of the panel to adjacent panels by a screwed assembly joint is possible.

To improve the carrying capacity of the sheet metal of the lining, there are vertical stiffeners, for example in the form of L-shaped steel sections.

To accommodate horizontal forces, preferably diagonal braces are mounted on the frame. They can be made from round pipe, H- section or U-section. Especially round pipe has proven effective for this purpose since it has an especially favorable ratio of area and thus weight to buckling resistance. It is thus an optimum profile for dissipating compressive forces. Moreover, round sections in the most varied cross sections can be easily procured worldwide so that prefabricated frames can be later matched to the load influences prevailing at the erection site.

The diagonal of the round pipe can be matched to the required cross section for the same outside dimension, i.e., the same diameter, via the wall thickness. Matching to the other installations, e.g., to the piping, remains unaffected by these changes.

Alternatively, for the correspondingly small horizontal forces, stiffening can also take

place without a diagonal, for this purpose via the lining sheet metal.

Preferably the frames extend over the entire length or width of one side surface of the enclosure. The inherent weight of the enclosure and the vertical forces from the external effects are then advantageously taken up only by the vertical U-sections of the frame that are located in the corners of the enclosure. Middle supports are avoided as much as possible. If the cross section of the vertical U-sections is not sufficient to accommodate the forces, the corner supports are further reinforced by welded-on sections. With few supports, the inherent weight of the enclosure is dissipated in a more concentrated manner; the individual supports each take up higher compressive forces. The tensile forces that result from effects that act externally, such as, for example, wind or earthquakes, are thus better compensated in this way, and the anchoring can be dimensioned to be smaller.

Advantageously, the sheet metal lining is steel sheet 3 to 5 mm thick. When the sheet metal thickness is fixed, a compromise between the static supporting capacity of the sheet metal, its workability and its weight must be found. A sheet metal thickness of 4 mm has proven especially favorable in this respect.

The individual panels are preferably screwed to one another. In order to achieve a gas-tight enclosure, it is then additionally necessary to seal the contact points of the panels. To do this, preferably a weld is used. It can be done with a small weld cross section since the static forces are accommodated by a screw connection, and the weld is attached only for sealing purposes.

The enclosure according to the invention compared to the prior art has numerous

advantages. The enclosure can be matched to the most varied plant engineering boundary conditions, for example, different column heights, or variable dimensions of the heat exchanger blocks. In principle, cylindrical boxes can also be produced according to the invention. Engineering processing can take place in parallel by consequent separation of the space-enclosing and statistically required elements, or by the possibility of being able to easily reinforce the space-enclosing elements. The conventional processing sequences (first basic engineering, then statistical analysis, then shop drawings, and, at the end, purchase of material and work preparation) need not be observed. Extensive overlapping is possible, for example the shop drawings can be processed parallel to statistical analysis. This results in savings in processing time and thus shorter delivery times.

The cross sections and dimensions that are necessary for space enclosure, especially the U-sections of the panels, can for the most part be established independently of the specific project. The components that are dependent on the erection site can be considered via the parameter of the wall thickness of the sheet metal jacket or by additional reinforcing sections. Because most of the cross sections can be established beforehand, the panel-producing operation can purchase its material independently of the statistical analysis of the enclosure.

The panels can be prefabricated and as a result of their dimensioning can be easily transported to the erection site of the enclosure. The enclosure, moreover, has a construction based on components that are available worldwide and can thus be produced worldwide with sections that can be obtained on site without major interventions into the construction.

The invention optimizes the fabrication of the enclosure since a host of identical panels

can be produced. Both in the design, statistical analysis, preparation of detailed drawings and also in the manufacture of the enclosure, the effects of repetition can be used both within the project and also encompassing the entire project. The project-specific cost for statistical analysis is distinctly reduced.

The dimensions and thus the weight of preassembled segments can be established depending on the existing crane capacities on site and the existing assembly possibilities, i.e., at a very late time. Early adaptation (in the basic phase) is no longer necessary. The welds necessary to achieve gastightness can be made up at any time since supporting connection takes place by screw unions of the panels. The utilization times of the cranes can be reduced.

The invention and other details of the invention are explained in more detail below based on the embodiments shown in the drawings. Here:

Figure 1 shows one part of an enclosure that is assembled according to the invention from panels,

Figure 2 shows a panel according to the invention,

Figure 3 shows a detailed view of the corner connection of two panels,

Figure 4 shows a subsection prefabricated from several panels,

Figure 5 shows a prefabricated ring that consists of several panels, and

Figure 6 shows a section prefabricated from several panels according to the invention.

Figure 1 shows a partial structure of an enclosure according to the invention that is used as a cold box for holding components in a low-temperature air separation system. In the cold box, there are, for example, the low-pressure column and/or the main condenser and/or the raw

argon column with the corresponding accessory parts.

The illustrated cold box has a rectangular base surface with length L and width B. The height of the cold box is its extension in a direction perpendicular to the base surface. The side walls of the cold box are assembled from a host of panels 1a, 2a, 1b, 2b. The panels 1a and 2a and 1b and 2b are each made identically and in each case extend over the entire extension L and B of the corresponding cold box side wall.

Figure 2 shows a panel in greater detail. The panel consists of a rectangular frame of U-sections 3, 4 made of steel. The length of the U-sections 4 that run horizontally in the cold box after its erection corresponds in the illustrated example to the side length L of the cold box. The panels for the sides with the width B are made accordingly. The length of the U-sections 3 that run vertically in the assembled state is preferably 3 m.

The U-sections 3, 4 are joined into a rectangular frame. Diagonals 7 of round pipe are used to dissipate the horizontal loads. The entire frame is finally lined with sheet metal 8 that has a thickness between 3 and 5 mm, preferably 4 mm, and is reinforced with the vertically arranged sections 6.

At the planned erection site of the cold box, a foundation is built on which the lowermost panels 1a, 1b are mounted. Two panels 1a, 1b that border one another on the corner are moved into position and are screwed to one another.

Regardless of the installation on the foundation, preferably in the vicinity of the foundation, panels located farther above on the base frame can be preassembled into segments.

The connection of the panels 1a and 1b is detailed in Figure 3. The panels 1a and 1b are

arranged such that the base of the vertical U-section 3a of the panel 1a and one leg of the vertical U-section 3b of the panel 1b border one another. At the contact site, the two U-sections 3a and 3b are connected to one another via a screw connection 9. The contact point of the two U-sections 3a and 3b is then provided with a weld 10 in order to achieve a gastight connection of the two panels 1a and 1b.

The two vertical U-sections 3a and 3b and the corresponding vertical U-sections of the overlying panels, for example of the panels 2a and 2b (Figure 1), form the corner supports of the cold box. To reinforce the cold box corners, when statistically necessary, in addition an L-section 11 is welded on and extends over the height of several panels 1a, 2a or over the entire height H of the cold box and can be staggered according to the statistical requirements.

After completion of the lowermost panel ring 1a, 1b, the next panels 2a, 2b are positioned on the lowermost panel ring 1a, 1b and connected to it. To do this, the succeeding horizontal U-sections 4 of the lower panel 1a and the overlying panel 2a are screwed to one another. To produce a gastight cold box, the contact point of the two panels 1a and 1b is also provided with a weld. The corner connection of the panels 2a and 2b of the upper panel ring takes place in the manner explained above using Figure 3.

If necessary, in addition, supports 12 (see Figure 1) can be placed in the cold box and can be attached to the panels, in order to mount, for example, pipelines or other modules on them. Analogously, there can be a walkway 13 on the outside of the enclosure.

Instead of the described construction of the cold box from individual panels 1a, 1b, 2a, 2b, prefabricated segments that consist of several panels can also be used.

Figure 4 shows, for example, a prefabricated element consisting of three panels 14, 15, 16, a so-called subsection. The panels 14, 15, 16 are screwed to one another before installation in the cold box, and the connecting points are sealed with welds. The complete subsection that consists of the three panels 14, 15, 16 is then installed as a single part in the side wall of the cold box. The number of panels of a subsection can be chosen according to conditions at the building site, e.g., depending on the existing crane capacity.

Figure 5 likewise shows a segment that has been prefabricated from several panels 17, 18, 19, 20. The individual panels 17, 18, 19, 20 in this version are not located on top of one another, but rather next to one another and are connected to one another such that they form a ring according to the size of the cold box. The complete ring is then positioned at the intended site on the cold box and is screwed to the underlying panels.

Figure 6 shows a third variant of prefabrication. One section of the endosure that is being formed is prefabricated from several panels. The panels lying next to one another form the outside dimensions L and B of the enclosure; the panels on top of one another form part of the overall height. The section can be built either from several panels, from prefabricated subsections, or rings. The height of the section is determined primarily by the existing crane capacities.

Of course, system parts or accessory parts, for example pipelines, cable shafts, valves or walkways and supports can be mounted on the prefabricated elements as well as to individual panels before installation in the cold box.

In addition to the above-described approach, to erect the enclosure at the building site and

to successively install the internals, the illustrated concept is also suited for the so-called packaged unit variant, i.e., installation of the enclosure, the installation of internals and piping horizontally, and subsequent transport of the entire cold box to the erection site.